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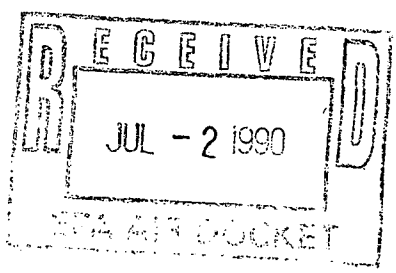
BEFORE THE
UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

| | |
|---|---|
| IN RE APPLICATION FOR A FUEL ADDITIVE WAIVER FILED BY ETHYL CORPORATION UNDER § 211(f)(4) OF THE CLEAN AIR ACT | ) |




**TESTIMONY IN SUPPORT OF THE HiTEC® 3000 FUEL ADDITIVE WAIVER APPLICATION**

**ETHYL CORPORATION**

**June 22, 1990**

**TESTIMONY OF RAY WILKINS, JR.**
**IN SUPPORT OF**
**HiTEC® 3000 FUEL ADDITIVE WAIVER**

**ETHYL CORPORATION**

**June 22, 1990**

## I. INTRODUCTION

Good morning. My name is Ray Wilkins, Jr. I am a Corporate Senior Vice President of Ethyl Corporation ("Ethyl") and President of its Chemicals Group. I am here to speak in support of Ethyl's waiver application for the HiTEC® 3000 Performance Additive ("the Additive"). With me today on the panel are Dr. Gary L. Ter Haar, Ethyl's Corporate Vice President for Health and Environment, and F. William Brownell of Hunton & Williams, Ethyl's counsel. Also present to assist us in answering questions regarding our waiver application are members of Ethyl's technical staff, and the independent consultants who analyzed Ethyl's test data.

My goal today is to provide a brief overview of the test programs and analyses which are described in detail in Ethyl's waiver application documents, and to answer questions concerning Ethyl's waiver application. I recognize that it may be appropriate to respond more fully to some questions in writing after the hearing.

By way of summary, HiTEC 3000 Performance Additive is an environmentally safe octane improver developed by Ethyl scientists. Our extensive tests show that use of our product not only boosts octane, but also reduces the overall level of

regulated tailpipe emissions -- including a significant reduction in NOx. The Additive saves crude oil and allows refiners to reduce aromatics and fuel vapor pressure. Furthermore, HiTEC 3000 is completely compatible with gasoline containing oxygenates.

## II. AN OVERVIEW OF ETHYL'S TEST PROGRAM

I will now continue with a description of the Additive and an overview of Ethyl's test program.

### A. The HiTEC 3000 Additive

As I have already indicated, the Additive is a manganese-based octane improver. The addition of about one-half teaspoon of the Additive in a 20-gallon tank of gasoline improves the octane number of the gasoline by about one octane number. This increase is achieved at approximately one-third the cost of the currently available alternatives for enhancing octane.

Twice before, Ethyl has sought EPA's approval to use the Additive in unleaded gasoline. Although EPA denied those requests due to insufficient supporting data, in both cases EPA invited Ethyl to reapply for a waiver whenever adequate data on the effects of the Additive on emission control systems were developed.

Since the completion of these two waiver application proceedings almost a decade ago, several hundred billion miles of vehicle service have been accumulated in Canada on gasoline containing the Additive. Moreover, we have completed a carefully designed test program in the United States. We believe that the

time is now right for broad use of the Additive in unleaded gasoline in the United States. For this reason, Ethyl has filed a new waiver application to allow use of the Additive in a concentration not to exceed 0.03125 grams manganese as HiTEC 3000 per gallon of unleaded gasoline.

B. **The Test Program and Statistical Analyses**

To obtain a waiver for use of the Additive, Ethyl must show that the Additive "will not cause or contribute to a failure of any emission control device or system" to meet the emission standards for which vehicles are certified under the Clean Air Act. To meet this requirement, Ethyl has conducted the most extensive series of vehicle emission and other tests ever undertaken by a private company. This test program was designed in consultation with both the automobile companies and the EPA staff.

This test program involved 48 cars operated for a total of more than 3 million miles. Half of the cars used a test fuel containing the Additive, and half used the same test fuel without the Additive. At each 5000 mile increment, independent laboratories measured the tailpipe emissions from each vehicle to determine what effect, if any, the Additive had on tailpipe emissions.

These data were then subjected to rigorous, independent statistical analyses, in order to evaluate the impact of the Additive over 75,000 miles of vehicle operation. These analyses show that the Additive substantially reduces emissions of

nitrogen oxides (NOx), while also reducing emissions of carbon monoxide (CO).

The reductions in NOx emissions are illustrated in Chart 1. You will note that the reductions in NOx emissions associated with use of the Additive begin almost immediately.

Chart 2 illustrates the overall reductions in CO emissions. The reductions in CO emissions begin to appear at about 25,000 miles and become more pronounced thereafter. These reductions for NOx and CO continue, and indeed increase in magnitude, as mileage accumulation increases.

The NOx and CO emission reductions result from two beneficial effects of the Additive. First, the Additive reduces engine out NOx and CO emissions. Second, manganese oxide acts as a catalyst, making the converter, and other components of the emission control system, more efficient in removing NOx. This NOx effect is addressed in a paper prepared by Dr. Roy Harrison of the University of Lancaster, England, and Dr. Harry Edwards of Colorado State University, which is part of Appendix 9 to the waiver application. We plan to submit additional information on this issue for the record in our written comments after the hearing.

You should also note that these reductions in NOx and CO emissions occur without a material change in hydrocarbon ("HC") emissions. Chart 3 illustrates the overall effect of the Additive on HC emissions. The independent statistical analyses performed by Systems Applications, Inc. ("SAI") and Roberson

Pitts, Inc. ("RPI") show a close correspondence between HC emissions for cars using the Additive and cars using clear fuel. Indeed, according to these analyses, the only statistically discernable change in emissions associated with use of the Additive occurs within the first 5000 miles of vehicle operation. This is a very small change -- an increase of only 0.017 grams per mile. At 50,000 miles, no additional, statistically discernable change in HC emissions is observed.

Chart 4 illustrates the average differences in emissions between the clear and Additive-fueled vehicles for each of the three pollutants.

As the statistical analyses of these data show, the very small increase in HC emissions will not cause or contribute to the failure of emission control systems to meet emission standards -- either existing standards or those that may result from proposed legislation. And even the very small emissions increase observed in the test program should not occur in commercial operation as refineries use the Additive in place of aromatics in unleaded gasoline. By comparison, EPA has granted other recent fuel additive waivers even though emissions of one pollutant clearly increased, as long as overall emissions decreased.

The very small increase in HC emissions observed in the test program therefore is not a reason for concern with respect to our application. At pages 46 to 56 of the waiver application and in Appendix 10, we provide a full explanation of why the slight HC

emission increase is unimportant as a practical matter. I urge you to closely review these materials. In addition, Shep Burton of SAI and Ralph Roberson of RPI, the independent consultants responsible for the statistical analyses of the data, are available to answer your questions regarding their analyses.

In sum, Ethyl has met the statutory standard. Moreover, based on the results of Ethyl's test program, total emissions in cars using the Additive (including reductions in noxious pollutants such as benzene and formaldehyde) could be reduced by up to 1.7 billion pounds per year by 1999. These pollutant reductions are summarized in Chart 5.

### C. Compatibility with Emissions Control and Combustion Systems

In addition to tailpipe emission testing, Ethyl also conducted extensive testing to determine what impact, if any, use of the Additive has on the materials used in automotive emission control systems. This testing shows that the Additive will not cause plugging of catalytic converters.

In fact, Ethyl's testing shows that catalytic converter efficiencies were actually improved by the presence of the Additive in the fuel. These results are summarized in Chart 6. The chart shows the average loss in converter efficiency for the clear and Additive-fueled test vehicles. Ethyl's testing also shows that use of the Additive will not adversely affect the operation of oxygen sensors or materials used in the automotive fuel systems.

Indeed, Petro-Canada, Inc., referring to the preliminary results of a study it commissioned to investigate whether the Additive causes plugging, recently observed that automobiles in Canada using fuel containing HiTEC 3000 up to twice the concentration requested in this waiver application have shown no signs of catalyst plugging after almost 100,000 miles of vehicle operation. Of particular note, the preliminary results of the study show that "the catalyst with the highest manganese level had the best performance in terms of emissions." A copy of a letter to the editor of Octane Week from which this information was derived is available for your review.

Our test program further confirms that there is no cause for concern with catalyst plugging or engine deposits. Appendix 3 and pages 33 to 37 of the waiver application present a more detailed explanation as to why these concerns are unfounded.

D. **The Additive Is Compatible With Reformulated Fuels**

In light of the ongoing efforts to reformulate gasoline to reduce automobile emissions, Ethyl has also conducted a series of tests to confirm the compatibility of HiTEC 3000 with reformulated fuels.

In one set of tests, we examined whether use of the Additive with a wide variety of fuel blends containing ethanol, MTBE, and methanol would adversely affect automotive materials. We found that it would not.

In a second set of tests, we examined the octane effectiveness of HiTEC 3000 in this same variety of fuel blends.

We found that the Additive complements the octane improving characteristics of other additives such as MTBE. These results are summarized in Chart 7. This means that HiTEC 3000 can be used to reduce the aromatic content of reformulated gasoline -- without sacrificing octane -- thereby further reducing emissions of both criteria pollutants and other pollutants such as benzene and formaldehyde.

In a third set of tests, we examined more directly the emissions effect of using the Additive in a reformulated fuel containing 5% MTBE. This testing confirms that the Additive will reduce significantly NOx emissions, will reduce the aromatic content of HC emissions, and will reduce CO emissions. These results are summarized in Chart 8.

The HC emission results are of particular interest. While total HC emissions remained about the same, the reactivity of those HC emissions decreased with use of the Additive. Testing of other fuel blends shows similar results. We will submit further information on this issue in our post-hearing comments.

Use of the Additive by refiners will also reduce butane production, the supply of which will be in surplus under new Reid Vapor Pressure regulations. With reduced butane, lower vapor pressure specifications for gasoline are more easily attained, and evaporative or running losses from vehicles in hot weather can be reduced.

In sum, the Additive is compatible with a wide variety of fuel blends, and the emission reductions made possible by use of

the Additive will complement the emissions reductions made possible by use of reformulated gasoline such as oxygenated fuels.

### E. Use of the Additive Will Have Beneficial Economic and Energy Consequences for the Nation

Use of the Additive will also allow refineries to operate under less severe conditions. As a direct consequence, crude oil imports could be reduced by about 30 million barrels per year. At $18 per barrel, this savings would amount to a reduction in imports of nearly $540 million per year, and would be more than the amount of oil stored annually in the Strategic Petroleum Reserve.

## III. Use of the Additive Will Have A Positive Impact on Public Health and Welfare.

Finally, I would like to emphasize that use of the Additive will have a positive environmental effect. As I discussed earlier, use of the Additive will result in substantial reductions in automobile exhaust emissions of both criteria pollutants and aromatics.

Use of the Additive will also reduce the emissions of pollutants from refineries, because use of the Additive allows refineries to operate under less severe conditions. These reduced levels of automobile and refinery emissions would, of course, translate into lower ambient concentrations of pollution and reduced population exposure to pollution.

In this regard, Ethyl asked SAI to examine the potential impact of use of the Additive on ambient ozone concentrations.

This analysis shows that modest, but nonetheless meaningful, reductions in ambient ozone concentrations could occur in some cities. In Philadelphia, for example, the reduction in ambient ozone concentrations would be the same as that achieved by removing approximately 170,000 cars from the streets of the city. These potential improvements would be the result, at least in part, of the lower reactivity of the automotive emissions attributable to use of the Additive.

It should also be emphasized that the manganese emissions associated with use of the Additive will be extremely small, on the order of five-one thousandths of a milligram per mile. As a result, the maximum increased ambient concentrations of manganese resulting from use of the Additive in a typical urban area such as Philadelphia would be only about 0.001 micrograms per cubic meter, a level nearly too small to measure.

EPA's own health review of manganese, the Health Assessment Document for Manganese (1984) ("HAD"), concludes that low level manganese emissions present **no** health concern. Indeed, an even more recent report completed by the Health Effects Institute, entitled "Potential Health Effects of Manganese in Emissions from Trap-Equipped Diesel Vehicles (1988)," concludes that emissions caused by use of manganese fuel additives in diesel-fueled vehicles present no public health risks, even at ambient manganese levels far in excess of those which would result from use of HiTEC 3000.

The overall effect of the Additive on public health and welfare therefore is positive -- it will lead to substantial reductions in the emissions of regulated pollutants and in reduced ambient concentrations of those pollutants, and will not cause any perceptible change in background concentrations of ambient manganese. I would like Dr. Ter Haar, Ethyl's Corporate Vice President for Health and Environment, to expand briefly on my remarks regarding public health.

## V. CONCLUSION

Ethyl has thoroughly and fairly documented in its waiver application that this Additive meets the statutory standard for approval of a waiver application. Chart 9 summarizes the results of Ethyl's test programs. Ethyl has shown that use of HiTEC 3000 will:

- Reduce NOx and CO tailpipe emissions.
- Have no practical, adverse effect on HC emissions.
- Enable a reduction of the aromatic content of unleaded gasoline.
- Facilitate compliance with tightened gasoline volatility standards.
- Reduce total pollutant emissions by 1.7 billion pounds annually by 1999.
- Potentially reduce ambient ozone concentrations in some cities.
- Save more crude oil annually than is purchased each year for the Strategic Petroleum Reserve.
- Be compatible with gasolines containing oxygenates, methanol, or ethanol.

- Cause no damage or deterioration of automobile emission control systems.
- Cause no health or environmental problems.

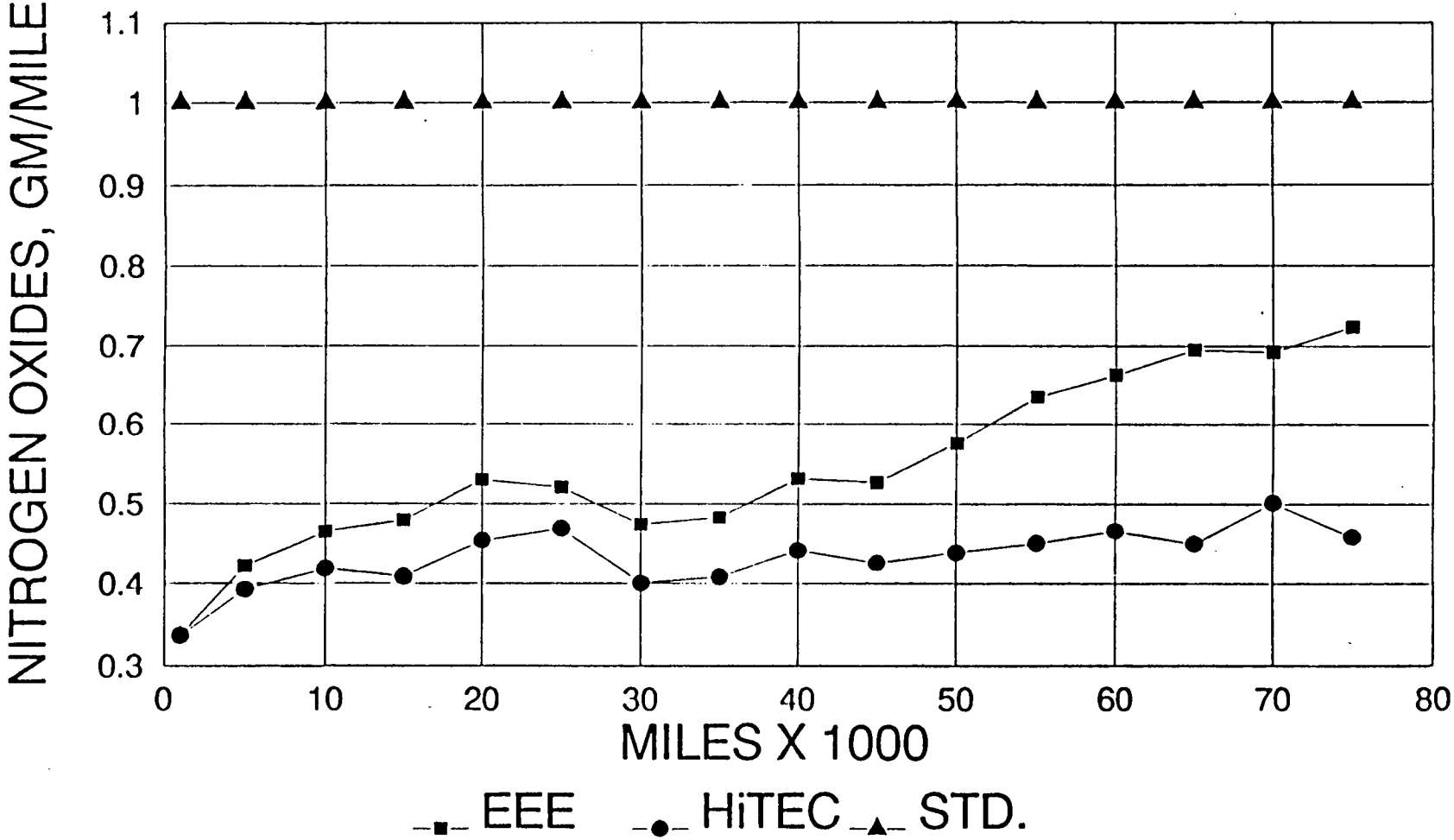
Ethyl therefore encourages prompt approval of its application.

Thank you for your attention.

CHART 1

# NITROGEN OXIDE EMISSIONS

## 48 - CAR TEST FLEET*

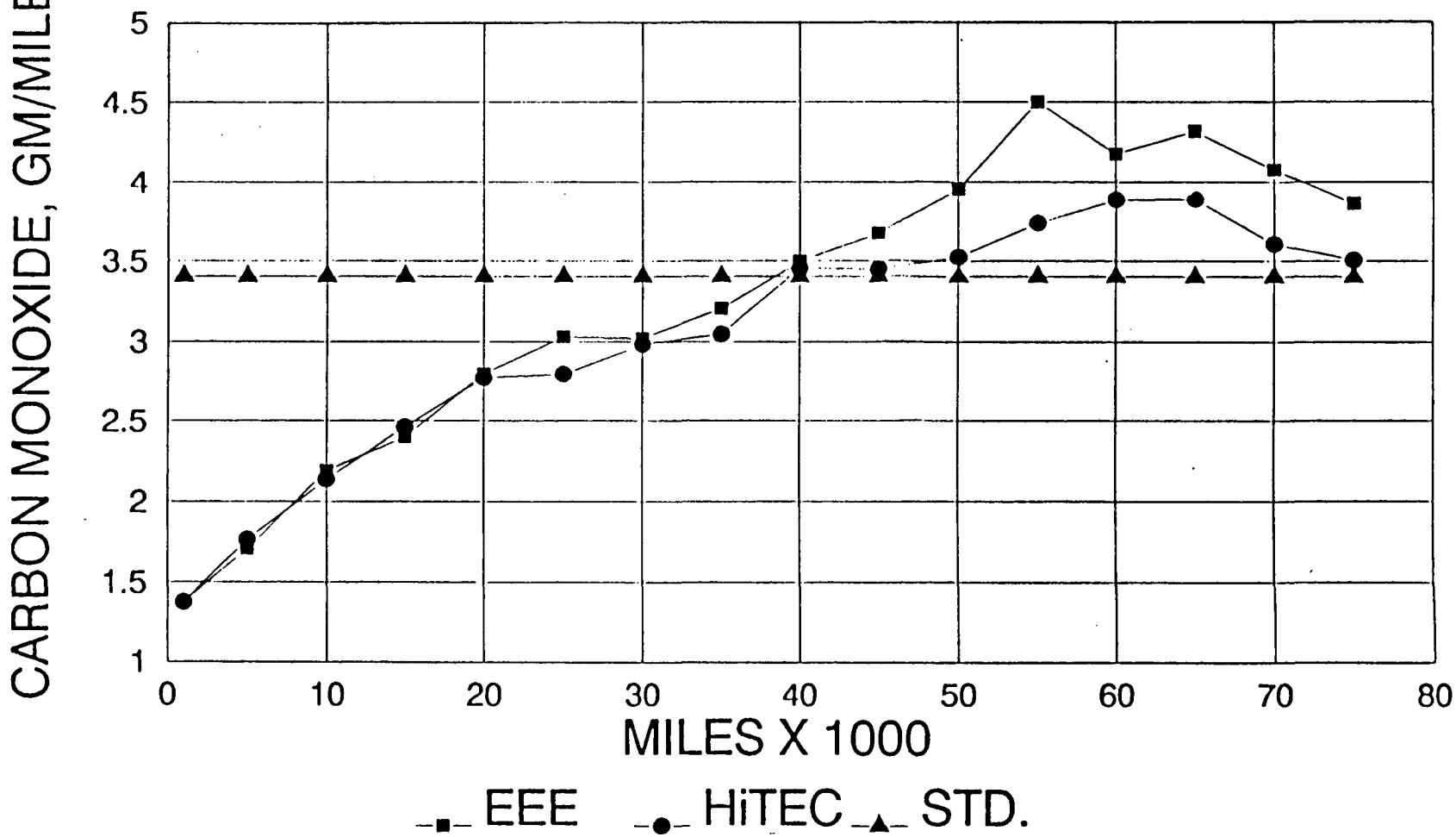



* Weighted Averages

CHART 2

# CARBON MONOXIDE EMISSIONS

## 48 - CAR TEST FLEET*

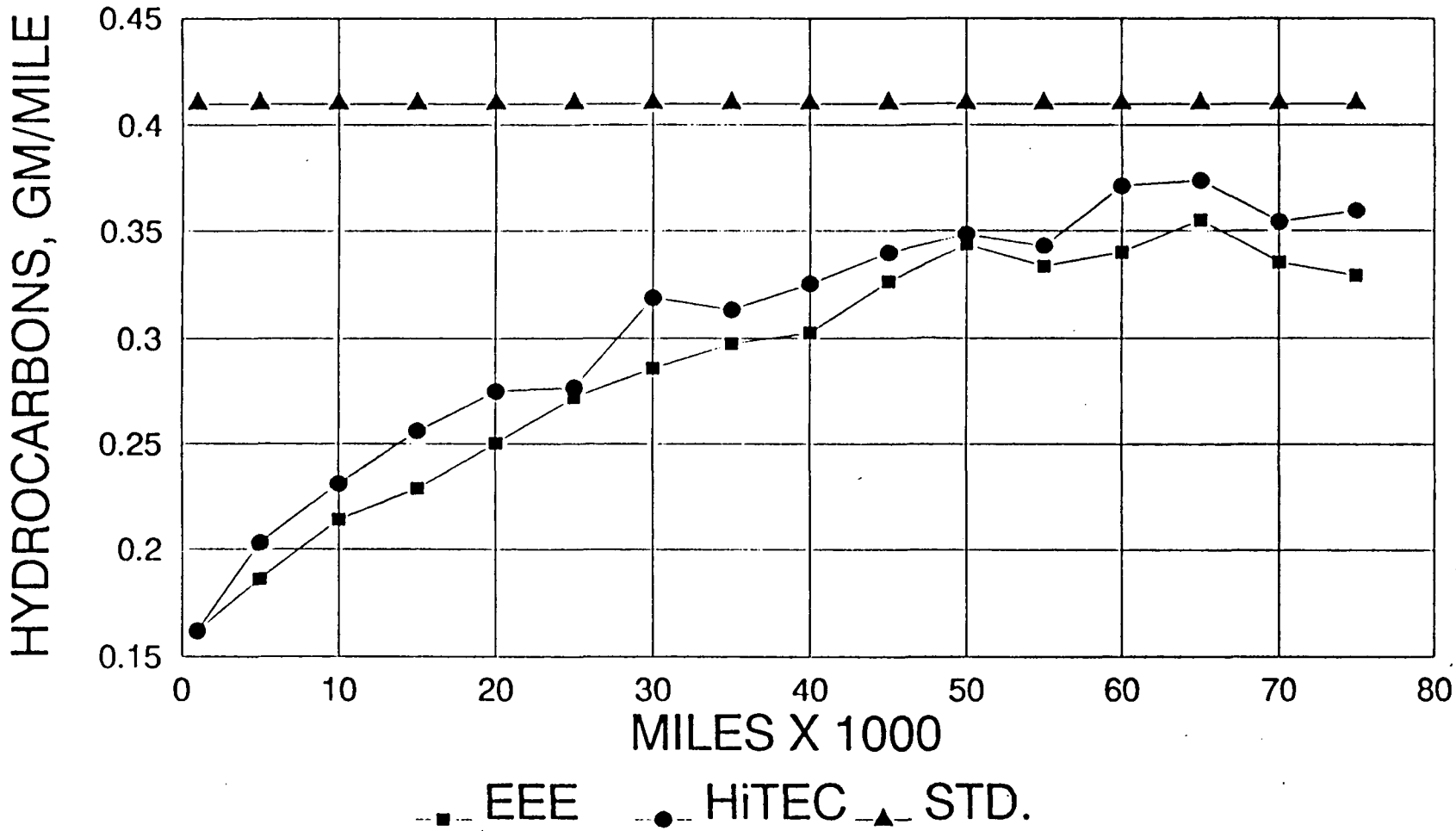



* Weighted Averages

CHART 3

# HYDROCARBON EMISSIONS

## 48 - CAR TEST FLEET*

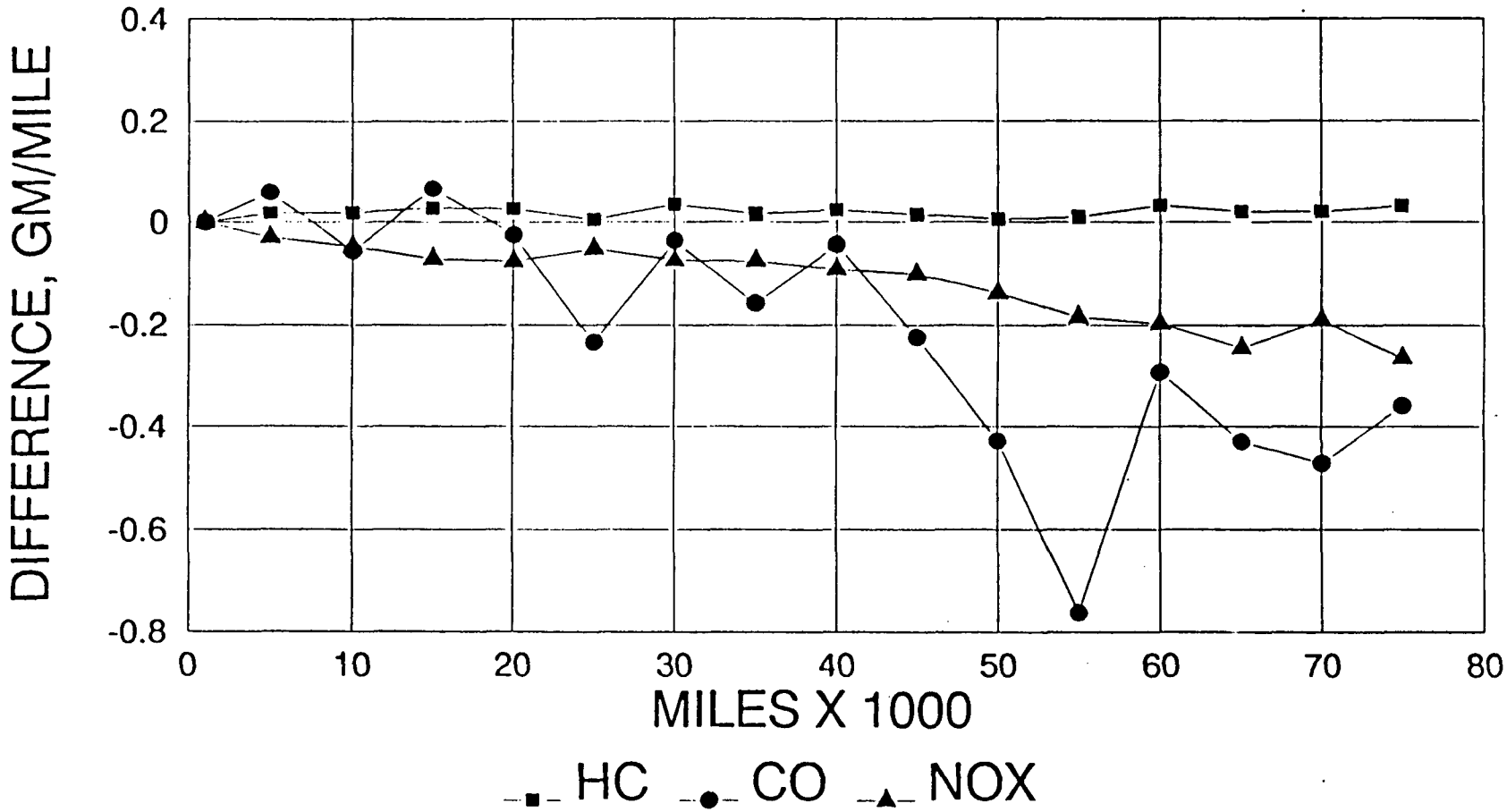



* Weighted Averages

CHART 4

# AVERAGE DIFFERENCE

## 48 - CAR TEST FLEET* (HiTEC-EEE)



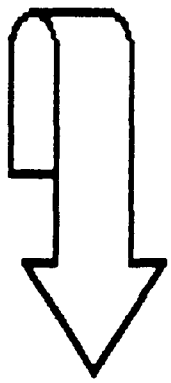

* Weighted Averages

# TOTAL POLLUTANT REDUCTION

## USE OF HiTEC® 3000 PERFORMANCE ADDITIVE

**(pounds per year)**

| Pollutant | 1999 |
|---|---|
| Nitrogen Oxide | 644,000,000 |
| Carbon Monoxide | 988,000,000 |
| Hydrocarbons* | 0 |
| Particulates | 1,100,000 |
| Sulfur Oxides | 150,000 |
| Aromatics | 35,200,000 |
| Formaldehyde | 3,500,000 |
| Total | 1,671,950,000 |



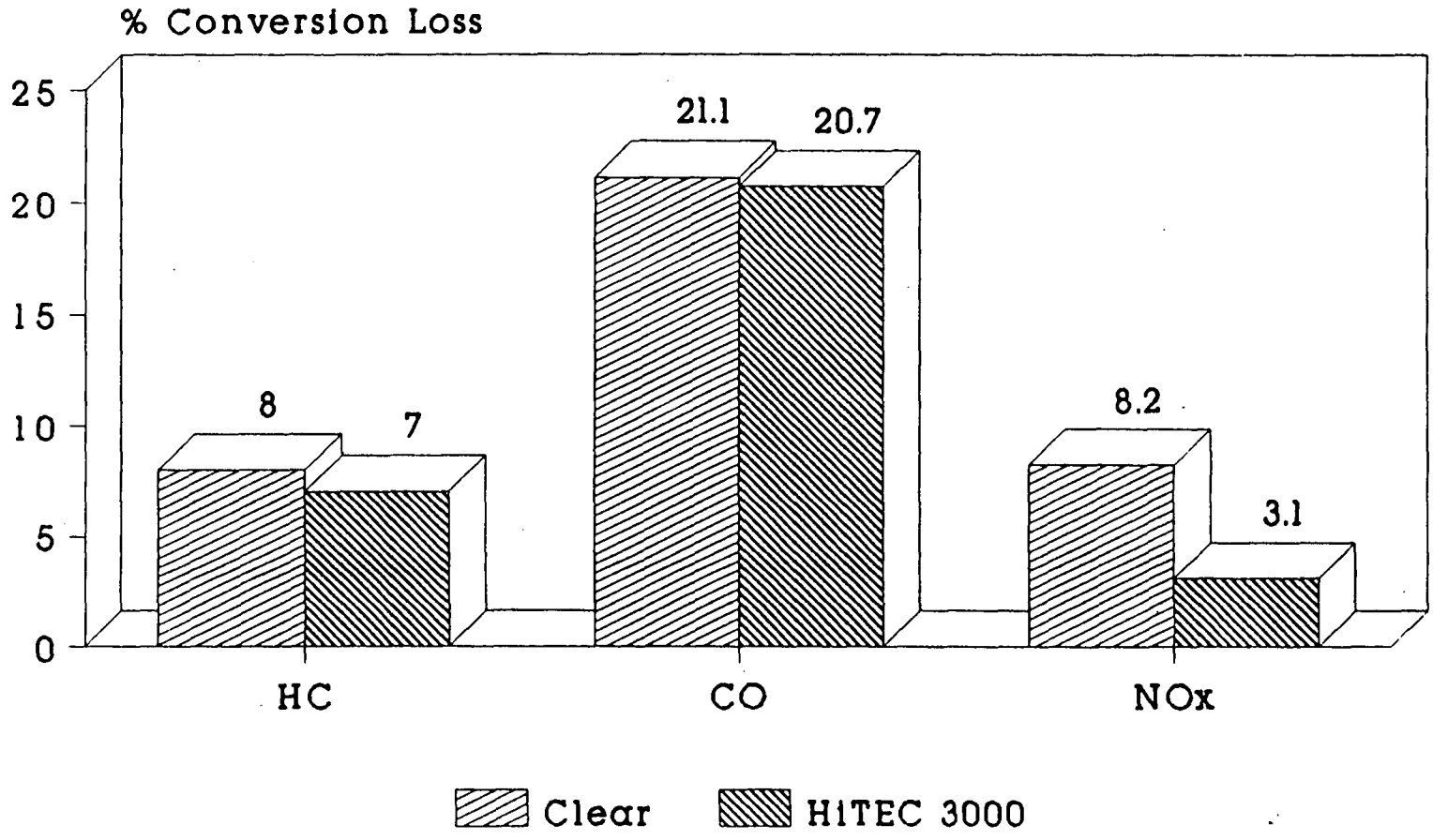
*assumes use of HiTEC® 3000 performance additive replaces aromatics in commercial fuel

CHART 6

# CATALYTIC CONVERTER PERFORMANCE

## Loss In Conversion Efficiency*

### 42 Vehicle Fleet




*1,000 Miles to 75,000 Miles

# OCTANE GAIN - HiTEC® 3000 & OXYGENATES
## *REGULAR GASOLINE*

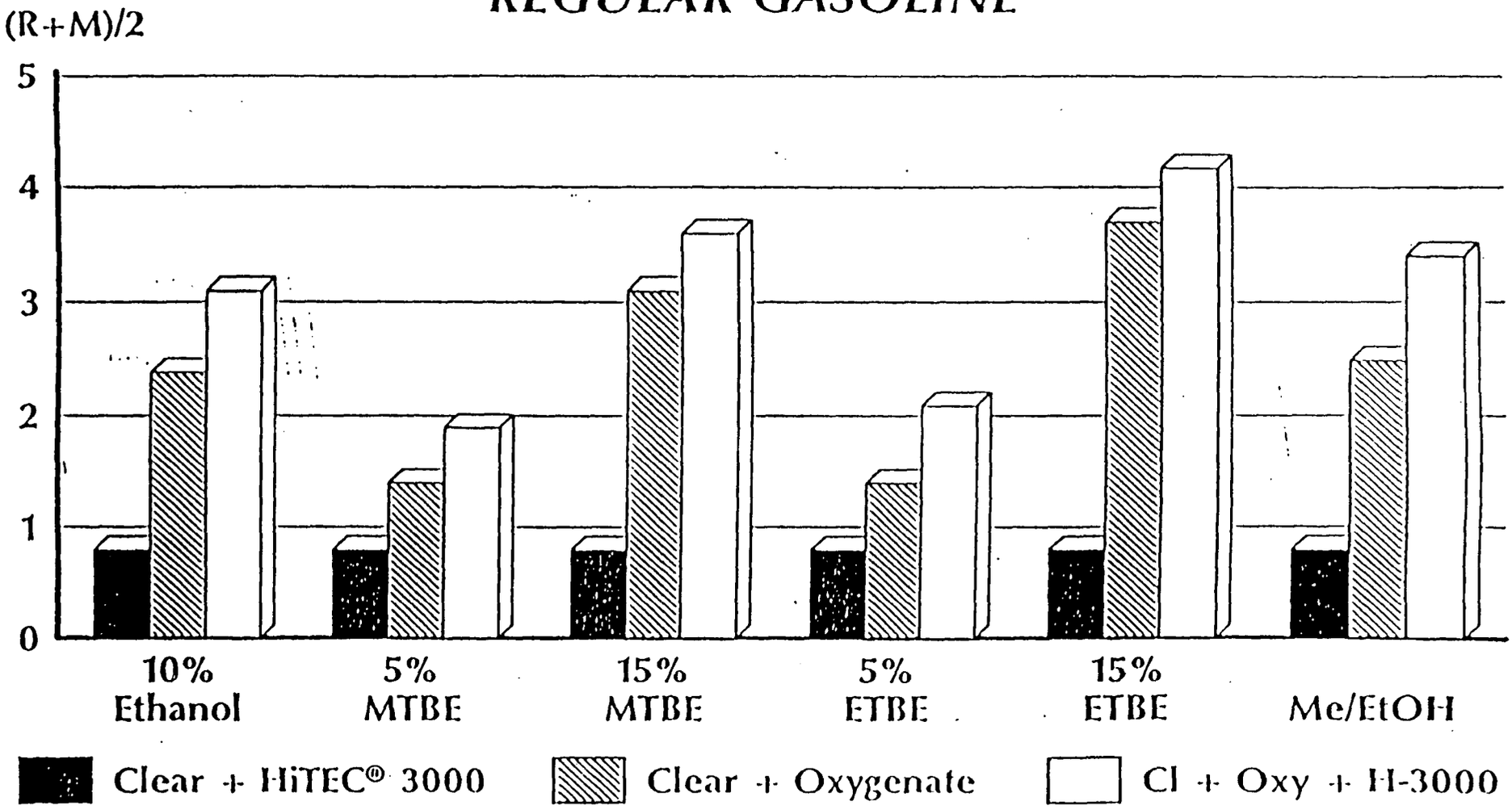
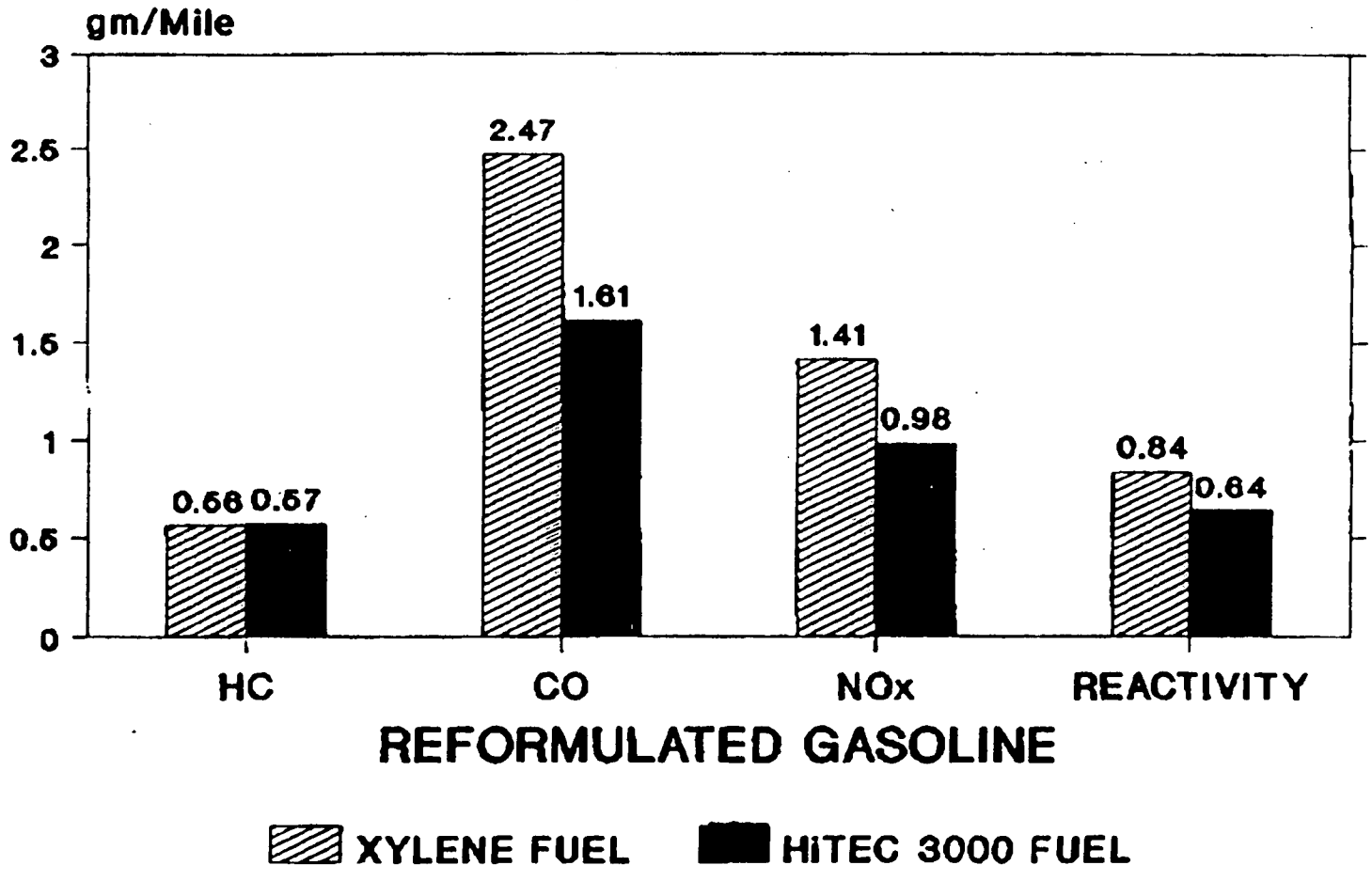



CHART 7

# FTP EMISSIONS & REACTIVITY-2 FLEET CARS
## Fuel Adjusted by Xylene or HiTEC 3000




Reactivity based on Carter Factors

CHART 8

# MAJOR FINDINGS OF THE ETHYL HiTEC 3000 TEST PROGRAM

- Reduces NOx and CO Tailpipe Emissions
- Has No Practical, Adverse Effect on HC Emissions
- Enables a Reduction of the Aromatic Content of Unleaded Gasoline
- Facilitates Compliance with Tightened Gasoline Volatility Standards
- Reduces Total Pollutant Emissions by 1.7 Billion Pounds Annually by 1999
- Potentially Reduces Ambient Ozone Concentrations in Some Cities
- Saves More Crude Oil Annually Than Is Purchased Each Year for the Strategic Petroleum Reserve
- Is Compatible with Gasolines Containing Oxygenates, Methanol, or Ethanol
- Causes No Damage or Deterioration of Automobile Emission Control Systems
- Causes No Health or Environmental Problems

CHART 9

**TESTIMONY OF DR. GARY L. TER HAAR**
**IN SUPPORT OF**
**HiTEC® 3000 FUEL ADDITIVE WAIVER**

**ETHYL CORPORATION**

**June 22, 1990**

Use of the HiTEC 3000 Performance Additive will result in infinitessimal additional emissions of manganese. As you can see from Chart 1, 99.9 percent of HiTEC 3000 is burned in the combustion process. The principal combustion product is Mn3O4. Based on testing of vehicles in the Ethyl test fleet, a current model automobile fueled on gasoline with the Additive would release about 0.06 grams (0.00006 kilograms) of manganese to the ambient air on an annual basis, or only about 0.5 grams of manganese over the course of 100,000 miles of vehicle operation. Chart 2 depicts the mean results of particulate emission testing on several of the test vehicles used in Ethyl's test program. You can see from the chart that, on average, only about 0.4 percent of the manganese added to the fuel is emitted to the ambient air.

As a result of these exceedingly small emissions, the Additive will have virtually no impact on ambient concentrations of manganese. For example, in a typical large urban area like Philadelphia, one could expect, conservatively, maximum increased ambient concentrations of manganese of only about 0.001 micrograms per cubic meter. By way of comparison, EPA has estimated that large point sources could cause maximum ambient manganese concentrations of over 100 micrograms per cubic meter. Data from the U.S. National Air Surveillance Network and from

Canada (where the Additive has been used in virtually all unleaded gasoline for over a decade) confirm what these estimates suggest -- that ambient concentrations of manganese are a function of normal background concentrations and large point sources, and that use of the Additive will have no discernable effect on ambient manganese concentrations. Chart 3 shows a comparison of airborne manganese levels in the United States, Canada, and the United Kingdom. You will note that the levels of ambient manganese are very low and essentially the same in all three countries. The levels of ambient manganese are comparable even though HiTEC 3000 has been, and is, used extensively in Canada, and has never been used in the United Kingdom.

These low ambient concentrations of manganese stand in sharp contrast to typical soil concentrations. Soil concentrations of manganese are typically 1000 parts per million, which can be explained by the fact that manganese is the 12th most abundant element in the earth's crust.

For this reason, manganese is also typically found in food products. In fact, food serves as the largest source of manganese for man. Chart 4 shows the manganese levels in several food groups. You can see from the chart that grains and cereals contain large concentrations of manganese, and that one cup of tea may contain as much as 1200 micrograms of manganese. Dietary

intake of manganese ranges from 2000 to 9000 micrograms per day, averaging about 3000 micrograms.

This daily dietary intake accounts for in excess of 99 percent of the amount of manganese absorbed by the body. Chart 5 shows that approximately three to four percent of the average daily intake of manganese is absorbed from the intestinal tract. This results in a typical daily uptake of 120 micrograms from dietary sources. The contribution from inhalation is miniscule in comparison. Only 0.4 micrograms are absorbed daily by inhalation. Since use of HiTEC 3000 would result in only 0.5 grams of manganese being emitted from a single automobile over the course of 100,000 miles of vehicle operation, typical ambient manganese concentrations will not change measureably. As a result, the amount of manganese absorbed from the diet is, and will continue to be, greater than 100 times the amount absorbed from the air, even if HiTEC 3000 is used in all gasoline.

It is also important to contrast this small inhalation uptake with existing occupational exposure limits. The limits are shown in Chart 6. These occupational exposure limits have been established to safeguard workers exposed 8 hours a day, 5 days a week for a lifetime from adverse health effects. They are many orders of magnitude higher than existing ambient manganese concentrations.

It should also be emphasized that, as Chart 7 shows, manganese is a biologically essential trace element. It has been recognized for some years as being present in trace quantities in the cells of all living organisms. A deficiency in manganese has been associated with skeletal abnormalities, impaired growth, ataxia of the newborn, and defects in lipid and carbohydrate metabolism.

Moreover, metabolism is controlled efficiently by homeostatic mechanisms, so that tissue concentrations are maintained at stable levels despite large variations in manganese intake. Indeed, manganese is present in most, if not all, vitamin supplements at levels of 1000 to 10,000 micrograms.

There are those who would suggest that no amount of manganese, however small, should be added to the environment. This is a simplistic view that ignores dose response relationships. All countries, including the United States, who have evaluated the health effect of low levels of manganese in air have concluded that there is no health risk from these levels. These scientists realize that appropriate risk assessments acknowledge the difference between toxic effects at very high levels of exposure and beneficial effects at lower levels for materials such as manganese. They further understand that an increase of uptake of less than one percent from daily

inhalation, when compared to what is normally absorbed in the diet, poses no health risk.

For example, studies by Canada's Ministry of Health and Welfare, the Canadian General Standards Board, Environment Canada and Transport Canada have determined that the Additive has no adverse environmental or health effects. The Ministry of Health and Welfare concluded that:

> Review of available limited information on industrial and community exposure to manganese and results of studies in animals of chronic inhalation of manganese exhaust products lead to the conclusion that there is no evidence at present to indicate that expected ambient manganese concentrations would constitute a hazard to human health.

A special Royal Society of Canada Commission came to a similar conclusion.

> MMT has already been used, however, for 8 years in unleaded gasoline. The additional exposure to manganese is well within the normal range represented by dietary variations, and is likely to remain so. W.C. Cooper's view (1984) that the general public has a wide margin of safety with respect to the worst case of MMT in gasoline, appears to be sound.

In the United States, the Environmental Protection Agency (EPA) has issued a health assessment document concluding that manganese emissions at levels found today present no public health concerns, even around large point-source emitters such as steel mills and power plants. EPA concluded that:

> present ambient air concentrations of manganese do not pose a significant risk to public health and that no regulation directed specifically at manganese is necessary at this time under the Clean Air Act.

In summary, the vast amount of practical experience from Canadian use of HiTEC 3000 and the significant body of knowledge produced in numerous studies all lead to the conclusion that HiTEC 3000 has no adverse effect on the environment or on human health.

CHART 1

CO503004.IMG 02/22/90:KTP

# COMBUSTION OF MMT

- 99.9+% of MMT is burned

- Combustion of gasoline containing MMT produces Manganese Oxides:

  MnO

  $MnO_2$

  $Mn_3O_4$ - Tetroxide is principal component

- Particle size:

  0.2 - 0.4 micrometers MMED

CHART 2

# AIRBORNE PARTICULATE EMISSIONS

## 1975 FTP-CVS Procedure

| Howell EEE | | Howell EEE with HiTEC 3000* | | | |
|---|---|---|---|---|---|
| | gm/Mile Total** | | gm/Mile Total** | u gm Mn/Mile | Percent Manganese Emitted |
| Average | 0.007 | Average | 0.004 | 5.0 | 0.39 |

*0.03125 gm Manganese per Gallon as HiTEC 3000
**Total Airborne Particulates

CHART 3

CO503012.IMG 02/22/90:KTP

# COMPARISON OF AIRBORNE MANGANESE LEVELS

## U.S., U.K. CANADA ($\mu/m^3$)

| | *URBAN* | *NON URBAN* |
|---|---|---|
| U.S. ("Norm" 1976-81)[1] | 0.038 | 0.009 |
| Ontario Canada (1982-87)[2] | 0.034 (Excluding cities with point sources) | 0.019 |
| | 0.070 (Including cities with point sources) | |
| U.K. (1976-79)[3] | 0.040 | 0.012 |

1. Data from U.S. EPA, Health Assessment Document for Manganese, 1984.
2. Data from Ontario Ministry of Environment, Air Quality Monitoring Report 1982-87.
3. Data from Warren Spring Laboratory, Multi-element and Sulphate in Particulate Surveys: Summary and Analysis of Five Years' Results (1976-81).

CHART 4



# MANGANESE LEVELS IN FOODS

*(µg/g WET WT)*

| | |
|---|---|
| Meat and eggs | 0.0-2.9 |
| Grains and cereals | 1.2-31 |
| Vegetables and fruits | 0.1-13 |
| Fish | .02-0.1 |
| Whole milk | 0.2 |
| Tea leaves | 276 |
| Cup of tea | 7 |

Dietary Intake - 2,000 TO 9,000 µg/DAY

Mean - 3,000 µg/DAY

6 oz. cup of tea may contain 1,200 µg Mn

CHART 5



# ESTIMATED DAILY ADULT EXPOSURE TO MANGANESE

| | |
|---|---|
| **Daily Intake** | |
| Food and Water | 2,000-9,000 µg (use 3,000 µg mean) |
| Absorption Rate | 3-4% |
| Avg. Amount Absorbed | 120 µg |
| Air (0.04 µg/$m^3$:20$^3$ inhaled) | 0.8 µg |
| Absorption Rate | 25-50% |
| Avg. Amount Absorbed | 0.4 µg |
| Total Daily Uptake (Food and Water Plus Air) | 120.4 µg |

CHART 6

# OCCUPATIONAL EXPOSURE LIMITS TO MANGANESE

| | |
|---|---|
| U.S. | 5,000 ug/$m^3$ DUST<br>1,000 ug/$m^3$ FUME |
| WHO*/ | 300 ug/$m^3$ (RESPIRABLE Mn) |

*/ World Health Organization

CHART 7

CO503006.IMG 02/22/90:KTP

# ESSENTIALITY

Manganese demonstrated to be biologically essential in mice, rats, rabbits and guinea pigs.

Accepted that 50 mg/kg in diet adequate for most laboratory animals.

Homeostasis - manganese tissue and blood levels are maintained at stable levels despite large variations in manganese intake.

Blood levels are approximately 1 μg/100 ml.

Manganese present in vitamin supplements at levels of 1,000 μg - 10,000 μg.

CHART 8

CO503021.IMG 02/22/90:KTP

# HEALTH ASSESSMENT OF MANGANESE AND/OR MMT

## *Canada Health and Welfare - 1978*

- **Methylcyclopentadienyl manganese tricarbonyl (MMT)-assessment of the human health implications of its use as a gasoline additive concluded:**

> **"Review of available limited information on industrial and community exposure to manganese and results of studies in animals of chronic inhalation of manganese exhaust products lead to the conclusion that there is no evidence at present to indicate that expected ambient manganese concentrations would constitute a hazard to human health."**

CHART 9



ROYAL SOCIETY OF CANADA COMMISSION ON LEAD IN THE ENVIRONMENT
(Lead in Gasoline - Alternatives to Lead in Gasoline - February, 1986)

MMT has already been used, however, for 8 years in unleaded gasoline. The additional exposure to manganese is well within the normal range represented by dietary variations, and is likely to remain so. W. C. Cooper's view (1984) that the general public has a wide margin of health safety with respect to the worst case of MMT in gasoline, appears to be sound.

CHART 10



# HEALTH ASSESSMENT OF MANGANESE AND/OR MMT

## *U.S EPA - August, 1984.*

- Health assessment document for manganese resulted in EPA announcing in official Federal Register, August 13, 1985 that

> "The Environmental Protection Agency has determined that present ambient air concentrations of manganese do not pose a significant risk to public health and that no regulation directed specifically at manganese is necessary at this time under the clean air act."

- EPA findings were

(A) Public exposure to manganese is far below any level associated with non-carcinogenic serious health effects.

(B) Evidence currently available does not indicate that manganese is carcinogenic.